Maintaining abstinence from smoking after a period of enforced abstinence – systematic review, meta-analysis and analysis of behaviour change techniques with a focus on mental health

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ABSTRACT

Background: Smoking prevalence is doubled among people with mental health problems and reaches 80% in inpatient, substance misuse and prison settings, widening inequalities in morbidity and mortality. As more institutions become smoke-free but most smokers relapse immediately post-discharge, we aimed to review interventions to maintain abstinence post-discharge.

Methods: MEDLINE, EMBASE, PsycINFO, CINAHL, and Web of Science were searched from inception to May 2016 and randomised controlled trials (RCTs) and cohort studies conducted with adult smokers in prison, inpatient mental health or substance use treatment included. Risk of bias (study quality) was rated using the Effective Public Health Practice Project Tool. Behaviour change techniques (BCTs) were coded from published papers and manuals using a published taxonomy. Mantel-Haenszel random effects meta-analyses of RCTs used biochemically verified point-prevalence smoking abstinence at a) longest and b) six-month follow-up.

Results: Five RCTs (n=416 intervention, n=415 control) and five cohort studies (n=471) included. Regarding study quality, four RCTs were rated strong, one moderate; one cohort study was rated strong, one moderate, three weak. Most common BCTs were pharmacotherapy (n=8 nicotine replacement therapy, n=1 clonidine), problem solving, social support, and elicitation of pros and cons (each n=6); papers reported fewer techniques than manuals. Meta-analyses found effects in favour of intervention [a) RR=2.06, 95% CI: 1.30-3.27; b) RR=1.86, 95% CI: 1.04-3.31].

Conclusion: Medication and/or behavioural support can help maintain smoking abstinence beyond discharge from smoke-free institutions with high mental health comorbidity. However, the small evidence base tested few different interventions and reporting of behavioural interventions is often imprecise.

INTRODUCTION

Smoking prevalence among people with mental health problems is about twice as high as in the population as a whole and increases with severity of illness, in some instances reaching up to 80% (McManus S, 2016, Royal College of Physicians and Royal College of Psychiatrists, 2013). Smoking prevalence in those with mental health problems has not seen the same decline as in the general population (Cook *et al.*, 2014, Szatkowski and McNeill, 2015). Smoking is the main contributor to a gap in life expectancy of 8 to 22 years between those with and without mental health problems (Brown *et al.*, 2010, Chang *et al.*, 2011, Lawrence *et al.*, 2013, Tam *et al.*, 2016, Wahlbeck *et al.*, 2011). This affects a large number of people as it has been estimated that one third of smokers have a mental health problem (Royal College of Physicians and Royal College of Psychiatrists, 2013). Prevalence of smoking and mental health problems is also higher among other disadvantaged groups, such as offenders and people with drug and alcohol dependence (Royal College of Physicians and Royal College of Psychiatrists, 2013) in prisons and substance use treatment settings, smoking prevalence in excess of 80% has been observed in some countries (Hickman *et al.*, 2015). Evidence suggests that cessation benefits not just physical, but also mental health (Taylor *et al.*, 2014).

Recently, some efforts to address this inequality have been made, including the introduction of comprehensive smoke-free policies in secondary care settings and prisons (National Institute for Health and Care Excellence, 2013, Working Group for Improving the Physical Health of People with SMI, 2016), ideally involving both smoke-free policies in buildings and grounds and integrated treatment for temporary abstinence and quitting (Kleber *et al.*, 2007, National Institute for Health and Care Excellence, 2013, Working Group for Improving the Physical Health of People with SMI, 2016). Staying in a smoke-free facility can provide a possibly rare period of abstinence from smoking and provides an opportunity to initiate long-term change to reduce morbidity and

mortality. However, the risk of relapse after leaving is extremely high (Clarke *et al.*, 2013, Prochaska *et al.*, 2006) and there appears to be little routine support to maintain abstinence and little evidence on interventions that may reduce the risk of reverting to smoking. An existing review of interventions to maintain abstinence in hospitalised patients (Rigotti *et al.*, 2012) specifically excluded patients from facilities that predominantly treat psychiatric conditions or substance abuse, meaning there is a particular lack of information on the extant evidence in these disadvantaged populations. One previous review summarised the impact of smoke-free psychiatric hospitalization on patients' smoking (Stockings *et al.*, 2014a). Institutions with incomplete smoke-free policies that were not necessarily providing any behavioural or pharmacological support to achieve abstinence were included in the review and the authors concluded that adherence to the smoke-free policy and receipt of treatment are likely to be important factors for patients' smoking.

We aimed to systematically review randomised controlled trials and cohort studies to identify pharmacological or behavioural interventions provided during the stay or post-discharge to maintain abstinence in smokers after a period of enforced abstinence in smoke-free facilities for mental health, substance misuse treatment centres or prisons. A secondary aim was to identify intervention components to guide development of future interventions.

METHODS

The review is registered as PROSPERO 2016:CRD42016041840.

Inclusion criteria

The review included randomised controlled trials (including feasibility and pilot trials) and observational cohort studies with participants who were adult smokers (18 or older), abstinent

because of a stay in a smoke-free prison, mental health or substance use treatment centre and followed up post-discharge. Institutions with partial smoke-free policies were included if participants had no access to smoking areas. In addition to a smoke-free setting, at least minimal support had to be offered. This could include any type of behavioural or pharmacological intervention aimed at maintaining abstinence from smoking following discharge, delivered during the stay and/or post-discharge. No limits were applied to control conditions where applicable.

Outcome measures

Primary outcome:

i. Biochemically verified continuous smoking abstinence at longest follow-up (West *et al.*, 2005).

Secondary outcomes:

i. Biochemically verified continuous smoking abstinence at six months

ii. Biochemically verified point-prevalence (seven-day) smoking abstinence at longest follow-up

iii. Biochemically verified point-prevalence smoking abstinence at six months

iv. Self-reported continuous abstinence at longest follow-up

v. Self-reported continuous smoking abstinence at six months.

vi. Self-reported point-prevalence abstinence at longest follow-up

vii. Self-reported point prevalence smoking abstinence at six months

viii. Other changes in smoking behaviour: a. Time to first cigarette post-discharge; b. Change in cigarette consumption at follow-up compared with the period prior to the enforced abstinence.

Search strategy and selection of studies

MEDLINE, EMBASE, PsycINFO, CINAHL and Web of Science were searched up to 25 May 2016. The search strategy included search terms relating to the population (smokers, mental health or substance use inpatients or prisoners), intervention (smoking cessation), outcome (relapse,

maintenance) and study types (cohort studies, clinical trials). Searches were limited to studies in English and adults. A full search strategy is in the online supplement (A1). Endnote X7 was used to record publications at all stages of the selection process. One reviewer (ES) screened all titles and abstracts of studies. Full text screening was undertaken by three authors; two reviewers (ES and LB) independently screened all papers and disagreements were settled by a third reviewer (AMcN); Kappa was calculated as a measure of agreement.

Data extraction

Using a pre-defined table, relevant data were extracted from all included studies by one reviewer and checked by a second reviewer.

Assessment of risk of bias

Risk of bias (study quality) was assessed independently by two reviewers using the Effective Public Health Practice Project tool (EPHPP). The tool has been designed to assess different study designs including randomised controlled trials and cohort studies. It consists of six sections: a) selection bias, b) study design, c) confounders, d) blinding, e) data collection method, f) withdrawals and dropouts; each section is rated as strong, moderate or weak. A study is rated as overall of strong quality if no section has been rated weak, moderate if one section is rated weak, and weak if two or more sections have been rated weak (Armijo-Olivo *et al.*, 2012). Differences in assessment were discussed to arrive at an agreed assessment.

Data synthesis

For trials, two pre-specified Mantel-Haenszel random effects meta-analyses were conducted using RevMan 5.3 (Higgins and Green, 2011). The strongest available outcomes were used. For both analyses, those lost to follow-up were treated as non-abstinent with the exception of nine deceased participants (West *et al.*, 2005). Subgroup analyses by setting (prison, substance abuse,

mental health) were planned. Observational studies were summarised in a narrative synthesis. Intervention components were coded using the Behaviour Change Technique (BCT) taxonomy (Michie *et al.*, 2015) which defines 93 behaviour change techniques organised into 16 clusters Authors of eight studies were contacted for treatment manuals or treatment protocols as evidence indicates that descriptions in published papers are less comprehensive (Lorencatto *et al.*, 2013); authors for the remaining two studies could not be contacted (Jonas and Eagle, 1991, Joseph, 1993). A manual used in one trial (Clarke *et al.*, 2013), a manual used in two trials (Hickman *et al.*, 2015, Prochaska *et al.*, 2014) and detailed descriptions for another trial (Stockings *et al.*, 2014b) and two cohort studies (Strong *et al.*, 2012, Stuyt, 2015) were provided; interventions in the other four studies were coded based on descriptions in the published papers. It was explored whether any link between behaviour change techniques used and outcomes of interventions could be hypothesised.

RESULTS

Description of studies

The search identified 8,417 records; ten studies with a total N=1302 were included in the review (Figure 1). Eight studies had been selected by both initial reviewers; kappa was 0.71.

Five studies (Clarke *et al.*, 2013, Gariti *et al.*, 2002, Hickman *et al.*, 2015, Prochaska *et al.*, 2014, Stockings *et al.*, 2014b) were trials (intervention n=416, control n=415), five (Jonas and Eagle, 1991, Joseph, 1993, Prochaska et al., 2006, Strong et al., 2012, Stuyt, 2015) were observational cohort studies (n=471). One study was conducted in Australia (Stockings *et al.*, 2014b), all others in the US. One trial was conducted in a prison (Clarke *et al.*, 2013), one trial and one cohort study in substance use treatment settings (Gariti *et al.*, 2002, Joseph, 1993), two trials and three cohort

studies in mental health treatment settings (Hickman *et al.*, 2015, Jonas and Eagle, 1991, Prochaska *et al.*, 2006, Prochaska *et al.*, 2014, Strong *et al.*, 2012) and one trial and one cohort study in mixed substance use and mental health settings (Stockings *et al.*, 2014b, Stuyt, 2015).

All institutions were described as having complete smoke-free policies and the average length of stay in the smoke-free environment differed considerably; it was 1.5 years in the prison setting (Clarke *et al.*, 2013), while all other studies measured the stay in days and the next longest was 90 days (Stuyt, 2015). Follow-up periods ranged from 3 months (Clarke *et al.*, 2013) to 18 months (Prochaska *et al.*, 2014) (Table 1). All randomised trials (Clarke *et al.*, 2013, Gariti *et al.*, 2002, Hickman *et al.*, 2015, Prochaska *et al.*, 2014, Stockings *et al.*, 2014b) and two of the observational cohort studies (Prochaska *et al.*, 2006, Strong *et al.*, 2012) used biochemically verified measures of seven-day point-prevalence smoking abstinence; the other three used self-reported abstinence (Jonas and Eagle, 1991, Joseph, 1993, Stuyt, 2015); only one trial reported continuous as well as point-prevalence abstinence (Stockings *et al.*, 2014b).

Reporting of effects of smoking cessation treatment or continued abstinence from smoking on mental health or substance use varied considerably across studies (Table 2). One trial found rehospitalisation to be less common in the intervention group (Prochaska *et al.*, 2014) and one cohort study found non-smokers to be less likely to relapse to other substances (Stuyt, 2015).

Intervention characteristics

Interventions used a number of theoretical approaches, and varied in intensity, content and mode of delivery (Table 1). In all but one trial (Gariti *et al.,* 2002), inpatient interventions were delivered by researchers, not clinic staff, whereas cohort studies generally reported on interventions delivered by clinic staff (with the exception of Strong *et al.,* 2012)

Post-discharge interventions were included in the five trials (Clarke *et al.*, 2013, Gariti *et al.*, 2002, Hickman *et al.*, 2015, Prochaska *et al.*, 2014, Stockings *et al.*, 2014b) and in one observational cohort study (Strong *et al.*, 2012). Telephone calls were used in three studies (Clarke *et al.*, 2013, Stockings *et al.*, 2014b, Strong *et al.*, 2012), ranging from one to eight calls between one day and four months post-discharge; two studies used a computer-generated intervention three and six months post-discharge (Hickman *et al.*, 2015, Prochaska *et al.*, 2014) and two provided an optional face-to-face appointment (Gariti *et al.*, 2002, Stockings *et al.*, 2014b) (one (Stockings *et al.*, 2014b) in addition to telephone support).

The trials used different control interventions that included treatment as usual (Gariti *et al.*, 2002, Prochaska *et al.*, 2014, Stockings *et al.*, 2014b), enhanced treatment as usual (Hickman *et al.*, 2015) and a health-related intervention matched for frequency and duration but not addressing smoking cessation (Clarke *et al.*, 2013).

Risk of bias

Four of the trials achieved a global rating of strong (Clarke *et al.*, 2011, Hickman *et al.*, 2015, Prochaska *et al.*, 2014, Stockings *et al.*, 2014b); one was rated moderate due to a risk of selection bias (Gariti *et al.*, 2002). One observational cohort study was rated strong (Prochaska *et al.*, 2006) the others were moderate or weak (Table 3).

Effects of interventions

Biochemically verified smoking abstinence

Continuous abstinence was reported in only one study (Stockings *et al.*, 2014b) at six months, two participants (1.9%) in the intervention group remained abstinent compared with none in the control group. Due to this lack of data, the primary outcome was not assessed in a meta-analysis.

The meta-analysis of seven-day point-prevalence abstinence at longest follow-up (3 to 18 months) included all five trials and found an overall effect in favour of intervention (RR=2.06, 95% CI: 1.30 to 3.27, Figure 2a). Overall, 12.7% of participants in the intervention groups achieved abstinence compared with 5.8% in the control groups.

The meta-analysis of seven-day point-prevalence abstinence at six months follow-up excluded the single trial conducted in a prison setting (longest follow-up was 3 months). The meta-analysis also found an effect in favour of intervention (RR=1.86, 95% CI: 1.04 to 3.31, Figure 2b); 10.5% and 5.5% respectively achieved abstinence. No heterogeneity was indicated for either meta-analysis. No further subgroup analysis by setting was conducted because only one trial was set exclusively in substance use (Gariti et al., 2002) and one trial was set in both mental health and substance use settings (Stockings *et al.*, 2014b).

Two observational cohort studies (Prochaska *et al.*, 2006, Strong *et al.*, 2012) aimed to use biochemically verified 7-day point prevalence abstinence. However, in one all patients reported smoking at the 3-month follow-up (Prochaska *et al.*, 2006), the other was a pilot study for intervention development and did not report results on verified abstinence (Strong *et al.*, 2012).

Self-reported smoking abstinence

Four cohort studies reported self-reported abstinence without biochemical verification (Jonas and Eagle, 1991, Joseph, 1993, Strong *et al.*, 2012, Stuyt, 2015). In one, four out of 39 psychiatric patients (10.3%) reported abstinence at 8 weeks post-discharge (Jonas and Eagle, 1991). In another study, 8.0% of patients admitted after the introduction of the smoke-free policy reported having quit smoking compared with 3.2% of patients admitted before introduction of the policy; however, length of follow-up differed, mean follow-up was 16 months for pre-policy and 11 months for post-policy patients (Joseph, 1993). In a pilot with 15 participants, six participants

reported a quit attempt with a median number of 62 abstinent days (range 2 to 110 days) (Strong *et al.*, 2012). A year after completing a 90-day substance misuse programme, an increase from 14% to 27% non-smokers among 140 patients was reported (Stuyt, 2015).

Other smoking outcomes – time to first cigarette

Time to first cigarette post-discharge was assessed in two trials and two cohort studies (Clarke *et al.*, 2013, Gariti *et al.*, 2002, Jonas and Eagle, 1991, Prochaska *et al.*, 2006). One trial and one cohort study reported that 76% of participants returned to smoking on the day of discharge (Gariti *et al.*, 2002, Prochaska *et al.*, 2006) and in another cohort study 72% of participants resumed smoking "immediately after discharge"(Jonas and Eagle, 1991). In the trial, 93% returned to smoking within a month with no group differences in the mean number of non-smoking days after discharge (Gariti *et al.*, 2002). In one cohort study, median time to first cigarette was 5 minutes and all participants returned to smoking within 36 days (Prochaska *et al.*, 2006), and in another, all participants who resumed smoking did so within eight weeks post-discharge (Jonas and Eagle, 1991). The other trial displayed information graphically indicating that over 70% in the control group and about 50% in the intervention group returned to smoking within one day; this study reported an effect of treatment in a survival model of days to first smoking lapse (hazard ratio=1.75, p=0.001) (Clarke *et al.*, 2013).

Other smoking outcomes – change in cigarette consumption

Change in cigarette consumption post-discharge compared with the period prior to the stay in a smoke-free environment was assessed in two trials and three cohort studies (Gariti *et al.*, 2002, Jonas and Eagle, 1991, Joseph, 1993, Stockings *et al.*, 2014b, Strong *et al.*, 2012). One trial found a significant reduction for both groups for the six months following hospitalization (24.6 reduced to 10.1 cigarettes per day for the intervention group and 23.8 to 9.4 cigarettes per day for the control

group, F(1)=21.07, p<0.001), with no group differences; self-reported reduction was supported by biochemical test results (Gariti *et al.*, 2002). The other trial found a significant effect of the intervention for 50% reduction in cigarettes per day, with 36.5% of intervention participants having reduced their cigarette consumption by six months versus 8.9% in the control group (p<0.0001) (Stockings *et al.*, 2014b). One cohort study reported a self-reported average decrease of seven cigarettes per day (95% CI: -13.80 to 0.51) with a group mean of 13 cigarettes at six-month follow-up (SD=8.35, IQR: 8.2 to 16.1) (Strong *et al.*, 2012). Another cohort study did not find any difference between self-reported number of cigarettes smoked per day at admission and six to 18 months post-discharge (21.6 (SD=13.6) vs 21.3 (SD=15.4) (Jonas and Eagle, 1991)). The third cohort study stated that around 20% of patients reported smoking less (without quantification) and no difference between patients treated before and after the introduction of a smoke-free policy (Joseph, 1993).

Behaviour change techniques

The number of BCTs that could be coded varied considerably between studies and was higher when manuals were available. It ranged from a single technique in published reports of two cohort studies (Jonas and Eagle, 1991, Prochaska *et al.*, 2006) to 34 BCTs (Clarke *et al.*, 2013) and 36 BCTs (Hickman *et al.*, 2015, Prochaska *et al.*, 2014) in trial manuals (Table 1).

All studies delivered at least one BCT from the 'Regulation' cluster. This cluster includes pharmacological support, reducing negative emotions, conserving mental resources and paradoxical instructions (the latter was not delivered in any study). No study included BCTs coded to be part of the 'Scheduled consequences' cluster, which includes ten BCTs focused on specific reward or punishment schedules (other incentives or rewards are included in a different cluster). Two trials covered all remaining 15 clusters (Hickman *et al.*, 2015, Prochaska *et al.*, 2014); the trial

(Clarke *et al.*, 2013) with the next highest number of BCTs covered 14 clusters, additionally omitting 'Comparison of behaviour'.

The most commonly used technique was pharmacological support (n=9). Pharmacological support in the form of nicotine replacement therapy (NRT) was used in four of the five trials (Gariti *et al.*, 2002, Hickman *et al.*, 2015, Prochaska *et al.*, 2014, Stockings *et al.*, 2014b), mostly in the form of patches, and this was available both during and after the stay in the smoke-free institution. In four of the five observational cohort studies (Jonas and Eagle, 1991, Prochaska *et al.*, 2006, Strong *et al.*, 2012, Stuyt, 2015), NRT was available only during inpatient treatment. One study mentioned availability of clonidine patches as part of treatment as usual (Joseph, 1993). The next most commonly used BCTs (all n=6, Table 2) were problem solving ('Goals and planning' cluster), unspecified social support ('Social support' cluster) and pros and cons ('Comparison of outcomes' cluster).

Generally, studies delivered fewer BCTs post-discharge than during the stay, with the exception of one trial (Stockings *et al.*, 2014b), which delivered a more comprehensive intervention after patients had left the hospital.

In addition to the BCTs described in the interventions, a smoke-free environment in itself delivers a number of BCTs for smoking cessation such as restructuring the physical environment (BCT 12.1), restructuring the social environment (12.2), avoidance/reducing exposure to cues for the behaviour (12.3) and removing access to the reward (7.4) (Michie *et al.*, 2015).

Due to the small number of studies, variable study designs and inconsistent outcome measures, associations between specific behaviour change techniques and outcomes could not be assessed statistically. The two trials reporting an overall positive effect (Clarke *et al.*, 2013, Prochaska *et al.*, 2014) differed in setting, length of stay, mode and intensity of intervention and length of follow-

up, but both used over 30 behaviour change techniques during the stay. Interestingly, one did not include pharmacotherapy (Clarke *et al.*, 2013), while the second did during the stay and post-discharge (Prochaska *et al.*, 2014). However, another trial using the same techniques as Prochaska *et al*., 2014 in a smaller sample from a similar population detected no effect (Hickman *et al.*, 2015).

DISCUSSION

A systematic search found only ten small studies researching maintenance of abstinence from smoking after a period of enforced abstinence in populations with high mental health comorbidity. Outside of trial intervention groups, no or minimal support for maintaining abstinence was delivered. Relapse to smoking occurred very quickly following discharge, and the four studies that reported it found that at least 70% of participants relapsed to smoking on the day of discharge. There was some evidence that providing behavioural or pharmacological interventions was effective for improving abstinence.

Evidence on how best to maintain or increase abstinence in this setting remains limited with few trials or high-quality observational studies. The trials mostly had a low risk of bias while the cohort studies by design were more likely to be affected by bias. In terms of outcome measures, although most used biochemical validation, few attempted to measure continuous abstinence, the strongest outcome (West *et al.*, 2005). However, in this population and setting, a floor effect for continuous abstinence at follow-up would be likely. A single study evaluated an intervention in a prison setting. There was little variety in location; all but one study had been conducted in the US. The interventions under study varied, but many evidence-based interventions have not been evaluated. For example, there is good evidence that contingency management is effective for increasing abstinence from smoking, although there is limited evidence in smokers with mental health problems (Cahill *et al.*, 2015, Hunt *et al.*, 2013). Pharmacotherapies were also limited and

no study tested varenicline (Cahill *et al.*, 2016) cytisine (Cahill *et al.*, 2016) or bupropion (Hughes *et al.*, 2014, Tsoi *et al.*, 2013, van der Meer *et al.*, 2013) which have all shown effectiveness.

Limitations of the review include that policies such as smoke-free institutions may be implemented without an evaluation of the effects in the peer-reviewed literature. However, we searched Web of Science, one source of grey literature. Another limitation is due to the complexity and reliability of coding BCTs (Abraham *et al.*, 2015), more experienced coders may have coded some aspects differently. However, the included analysis of BCTs for the first time provides evidence on components assessed in studies to date.

In contrast to the one previous review of the impact of smoke-free psychiatric hospitalisation on smoking (Stockings *et al.*, 2014a), the present review includes only longitudinal studies and includes non-psychiatric institutions with high prevalence of mental health problems. Additionally, in our review, smokers were exposed to complete smoke-free policies and received some intervention to support abstinence. The previous review findings suggested these are crucial for a stay in a smoke-free institution to have an effect on smoking (Stockings *et al.*, 2014a).

As in previous reports (Lorencatto *et al.*, 2013), we found some large differences between descriptions of behavioural interventions in some published reports and manuals. Most strikingly, coding from the manual instead of the publication increased the number of BCTs from four (Hickman *et al.*, 2015, Prochaska *et al.*, 2014) to over 30 each in two cases. Due to the small number of studies and their variable study designs and outcome measures, it remains difficult to draw any clear conclusions about associations between specific techniques and effects of the intervention.

The present evidence suggests that a larger number of BCTs from a wide range of clusters is more likely to result in an effective intervention. It is worth noting that even where the same BCTs are

included, delivery will differ (Lorencatto *et al.*, 2016, Lorencatto *et al.*, 2014, Tate *et al.*, 2016), e.g. in frequency, quality and fidelity which can impact effects, akin to medication effectiveness depending on the amount and duration of, and adherence to, treatment.

The present review focused on mental health; it is likely that interventions in other setting such as general hospitals would be transferrable to some extent. However, an existing Cochrane review covered these institutions (Rigotti *et al.*, 2012) while excluding institutions that primarily treat mental health problems or substance abuse. That review found evidence that interventions of the highest intensity, consisting of counselling that began in the hospital and continued for more than one month post-discharge, increased smoking cessation post-discharge; no benefit could be detected from the large number of studies with less intense interventions. The review also found that addition of NRT conferred a benefit while there was not enough evidence for clear conclusions on varenicline or bupropion when added to counselling (Rigotti *et al.*, 2012). For the present review, not enough studies were available to distinguish the impact of interventions delivered during the stay and post-discharge.

Reviews evaluating the evidence for preventing relapse for smokers in the general population who have successfully quit for a short time found some evidence for the use of NRT, bupropion or varenicline (Agboola *et al.*, 2010) but insufficient evidence to recommend the use of any specific behavioural intervention (Agboola *et al.*, 2010, Hajek *et al.*, 2013), indicating the general scarcity of evidence on maintaining abstinence in any population of smokers.

Future research should evaluate interventions in more diverse countries, policy settings and institutions that enforce abstinence as e.g. evidence for prisons is particularly lacking. Research on the effectiveness of interventions such as contingency management and pharmacotherapies other than NRT would be beneficial. Improved reporting is recommended; more comprehensive descriptions of interventions, potentially using frameworks such as the behaviour change

technique taxonomy (Michie *et al.*, 2015) would facilitate replication of studies and analysis of effectiveness of different intervention components. In addition, it would be beneficial to report clearly and comprehensively any effects of cessation treatment or cessation on mental health and substance use.

Conclusion

In populations with high rates of smoking and mental health comorbidity there is rapid and almost complete relapse to smoking after a period of enforced abstinence. Institutions implementing smoke-free policies need to also implement interventions to support sustained abstinence to help reduce inequalities in morbidity and mortality due to smoking. Interventions consisting of nicotine replacement and/or behavioural support can increase abstinence beyond discharge. However, the existing evidence base is small, tested only a narrow range of interventions and is limited by imprecise reporting of behavioural interventions. Pharmacological interventions other than NRT and additional behavioural interventions should be assessed and reported.

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Conflict of interest

None

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Table 1. Study description

Authors, publication details	Setting, country, n	Length of stay, intervention format, provider, mode	Inpatient intervention behaviour change techniques [b, c] (Michie *et al.*, 2015)	Post-discharge behaviour change techniques [c]	Control
RANDOMISED CONTROLLED TRIALS					
Clarke et al., JAMA Intern Med., 2013[a] (study protocol (Clarke *et al.*, 2011))	Prison, US, n=247	<u>Length of stay:</u> Measured as time since last cigarette smoked, M (SD) = 1.5 (3.4) years <u>Inpatient:</u> 6 sessions, sessions 1 and 6 based on Motivational Interviewing, sessions 2 to 5 based on CBT, delivered by Research Assistants, one-to-one. <u>Post-discharge:</u> Telephone calls 24 hours and 7 days post-discharge	*1.1 Goal setting (behaviour)* *1.2 Problem solving* *1.4 Action planning* *2.3 Self-monitoring of behaviour* *3.1 Social support (unspecified)* *3.3 Social support (emotional)* *4.1 Instruction on how to perform a behaviour* *4.2 Information about antecedents* *5.1 Information about health consequences* *5.4 Monitoring of emotional consequences* *5.6 Information about emotional consequences* *7.4 Remove access to the reward* *8.1 Behavioural practice/rehearsal* *8.2 Behaviour substitution* *8.3 Habit formation*	*1.5 Review behaviour goal(s)* *1.7 Review outcome goal(s)* *3.1 Social support (unspecified)* *10.4 Social reward*	<u>Inpatient:</u> Videos on health-related topics but not about smoking cessation. <u>Post-discharge:</u> Telephone calls 24 hours and 7 days post-discharge.

Authors, publication details	Setting, country, n	Length of stay, intervention format, provider, mode	Inpatient intervention behaviour change techniques [b, c] (Michie *et al.*, 2015)	Post-discharge behaviour change techniques [c]	Control
			8.4 Habit reversal *9.2 Pros and cons* *9.3 Comparative imagining of future outcomes* *11.2 Reduce negative emotions* *11.3 Conserving mental resources* *12.1 Restructuring the physical environment* *12.2 Restructuring the social environment* *12.3 Avoidance/reducing exposure to cues for the behaviour* *12.6 Body changes* *13.2 Framing/reframing* *13.4 Valued self-identity* *13.5 Identity associated with changed behaviour* *15.2 Mental rehearsal of successful performance* *15.3 Focus on past success* *15.4 Self-talk* *16.2 Imaginary reward*		

Authors, publication details	Setting, country, n	Length of stay, intervention format, provider, mode	Inpatient intervention behaviour change techniques [b, c] (Michie *et al.*, 2015)	Post-discharge behaviour change techniques [c]	Control
Gariti et al., Am J Drug Alcohol Abuse, 2002	Veterans Affairs Medical Center's detoxification unit for alcohol and other non-nicotine drugs, US, n=62	<u>Length of stay:</u> M = 7.4 days. <u>Inpatient:</u> One manual-based individual session delivered by Addiction Therapist, one-to-one. Participants encouraged to attend daily film series, Motivational enhancement (MET) post-film discussion in group. <u>Post-discharge:</u> Optional smoking cessation program delivered face-to-face by study co-investigator or nurse practitioner	3.1 Social support (unspecified) *5.3 Information about social and environmental consequences* *6.1 Demonstration of the behaviour* *9.2 Pros and cons* 11.1 Pharmacological support (nicotine patch	3.1 Social support (unspecified) 11.1 Pharmacological support (nicotine patch)	<u>Inpatient and post-discharge:</u> 3.1 Social support (unspecified) 11.1 Pharmacological support (nicotine patch) Optional smoking cessation program delivered face-to-face by study co-investigator or nurse practitioner
Hickman et	Three	<u>Length of stay:</u>	*1.1 Goal setting (behaviour)*	11.1 Pharmacological support	<u>Inpatient:</u>

Authors, publication details	Setting, country, n	Length of stay, intervention format, provider, mode	Inpatient intervention behaviour change techniques [b, c] (Michie *et al.*, 2015)	Post-discharge behaviour change techniques [c]	Control
al., Nicotine Tob Res, 2015[a]	psychiatric units (one non-acute and two acute units) in public acute care hospital, US, n=100 (3 deaths during follow-up)	47% stayed 2-7 days, 30% 8-13 days, 23% 2 weeks or longer Inpatient: Transtheoretical model-tailored computer-delivered intervention, self-help information, 15–30 minute on-unit individual motivational enhancement cessation counselling, delivered by study staff Post-discharge: Computer intervention repeated at 3 and 6 months, optional NRT for up to 10 weeks	*1.2 Problem solving* *1.4 Action planning* *1.9 Commitment* *2.4 Self-monitoring of outcome(s) of behaviour* 3.1 Social support (unspecified) *3.3 Social support (emotional)* *4.2 Information about antecedents* *5.1 Information about health consequences* *5.3 Information about social and environmental consequences* *5.6 Information about emotional consequences* *6.2 Social comparison* *6.3 Information about others' approval* *7.1 Prompts/cues* *8.1 Behavioural practice/rehearsal* *8.2 Behaviour substitution* *8.7 Graded tasks*	(NRT)	3.1 Social support (unspecified) 11.1 Pharmacological support (NRT) Delivered by study staff Post-discharge: Referrals (without NRT)

Authors, publication details	Setting, country, n	Length of stay, intervention format, provider, mode	Inpatient intervention behaviour change techniques [b, c] (Michie *et al.*, 2015)	Post-discharge behaviour change techniques [c]	Control
			9.2 Pros and cons *9.3 Comparative imagining of future outcomes* *10.3 Non-specific reward* *10.4 Social reward* *10.9 Self-reward* 11.1 Pharmacological support (NRT) *11.2 Reduce negative emotions* *12.1 Restructuring the physical environment* *12.2 Restructuring the social environment* *12.3 Avoidance/reducing exposure to cues for the behaviour* *12.4 Distraction* *12.5 Adding objects to the environment* *12.6 Body changes* *13.2 Framing/reframing* *13.5 Identity associated with changed behaviour* *15.2 Mental rehearsal of successful performance*		

Authors, publication details	Setting, country, n	Length of stay, intervention format, provider, mode	Inpatient intervention behaviour change techniques [b, c] (Michie *et al.*, 2015)	Post-discharge behaviour change techniques [c]	Control
			15.3 Focus on past success *15.4 Self-talk* *16.2 Imaginary reward*		
Prochaska et al., Am J Public Health, 2014[a]	Locked inpatient psychiatry unit at the Psychiatric Institute, US, n=224 (4 deaths during follow-up)	<u>Length of stay:</u> M (SD) = 7.4 (5.7) days, median = 6.0, mode = 5 <u>Inpatient:</u> Transtheoretical model-tailored computer-delivered intervention, 15–30 minute on-unit individual motivational enhancement cessation counselling, delivered by study staff <u>Post-discharge:</u> Computer intervention repeated at 3 and 6 months, optional NRT for	*1.1 Goal setting (behaviour)* *1.2 Problem solving* *1.4 Action planning* *1.9 Commitment* *2.4 Self-monitoring of outcome(s) of behaviour* 3.1 Social support (unspecified) *3.3 Social support (emotional)* *4.2 Information about antecedents* *5.1 Information about health consequences* *5.3 Information about social and environmental consequences* *5.6 Information about emotional consequences* *6.2 Social comparison*	11.1 Pharmacological support (nicotine patches)	<u>Inpatient:</u> 11.1 Pharmacological support (nicotine patches) <u>Post-discharge:</u> No intervention

Authors, publication details	Setting, country, n	Length of stay, intervention format, provider, mode	Inpatient intervention behaviour change techniques [b, c] (Michie *et al.*, 2015)	Post-discharge behaviour change techniques [c]	Control
		up to 10 weeks	*6.3 Information about others' approval* *7.1 Prompts/cues* *8.1 Behavioural practice/rehearsal* *8.2 Behaviour substitution* *8.7 Graded tasks* *9.2 Pros and cons* *9.3 Comparative imagining of future outcomes* *10.3 Non-specific reward* *10.4 Social reward* *10.9 Self-reward* 11.1 Pharmacological support (NRT) *11.2 Reduce negative emotions* *12.1 Restructuring the physical environment* *12.2 Restructuring the social environment* *12.3 Avoidance/reducing exposure to cues for the behaviour* *12.4 Distraction*		

Authors, publication details	Setting, country, n	Length of stay, intervention format, provider, mode	Inpatient intervention behaviour change techniques [b, c] (Michie *et al.*, 2015)	Post-discharge behaviour change techniques [c]	Control
			12.5 Adding objects to the environment *12.6 Body changes* *13.2 Framing/reframing* *13.5 Identity associated with changed behaviour* *15.2 Mental rehearsal of successful performance* *15.3 Focus on past success* *15.4 Self-talk* *16.2 Imaginary reward*		
Stockings et al., 2014[a] (study protocol Stockings et al., 2011)	One comorbid acute mental health and substance use unit and two acute mental	<u>Length of stay:</u> M (SD) = 22.6 (78.0) days <u>Inpatient:</u> Self-help smoking cessation literature, 10-15 minutes face-to-face motivational interview, delivered by study staff	3.1 Social support (unspecified) *5.1 Information about health consequences* *5.3 Information about social and environmental consequences* *5.6 Information about emotional consequences* *9.2 Pros and cons* *9.3 Comparative imagining of future outcomes* 11.1 Pharmacological support (NRT)	*1.2 Problem solving* *2.1 Monitoring of behaviour without feedback* *2.3 Self-monitoring of behaviour* 3.1 Social support (unspecified) *4.1 Instruction on how to perform a behaviour*	<u>Inpatient:</u> 3.1 Social support (unspecified) 11.1 Pharmacological support (NRT) Delivered by clinic staff <u>Post-discharge:</u> 11.1 Pharmacological support

Authors, publication details	Setting, country, n	Length of stay, intervention format, provider, mode	Inpatient intervention behaviour change techniques [b, c] (Michie *et al.*, 2015)	Post-discharge behaviour change techniques [c]	Control
	health units in public hospital, Australia, n=205	Post-discharge: 4 months of fortnightly telephone smoking cessation support with a designated counsellor, optional 12-week NRT (choice of patches, gums, lozenges, and inhalers), optional referrals to Quitline or smoking cessation groups		*4.3 Re-attribution* *5.1 Information about health consequences* *5.3 Information about social and environmental consequences* *5.4 Monitoring of emotional consequences* *7.1 Prompts/cues* *8.2 Behaviour substitution* *10.4 Social reward* 11.1 Pharmacological support (NRT) *12.2 Restructuring the social environment* *12.3 Avoidance/reducing exposure to cues for the*	(NRT, for three days upon discharge) Post-discharge smoking care plan and optional referral to Quitline

Authors, publication details	Setting, country, n	Length of stay, intervention format, provider, mode	Inpatient intervention behaviour change techniques [b, c] (Michie *et al.*, 2015)	Post-discharge behaviour change techniques [c]	Control
				behaviour *12.4 Distraction* *12.5 Adding objects to the environment*	
COHORT STUDIES					
Jonas & Eagle, 1991	Short-term psychiatric unit of a general hospital, US, n=39	<u>Length of stay:</u> M (SD) = 14.1 (7.0) days <u>Inpatient:</u> Nicotine gum and education in its use, self-help materials about smoking cessation, delivered by nursing staff <u>Post-discharge:</u> None	*11.1 Pharmacological support (NRT, gum)*		
Joseph, 1993	21-day residential	<u>Length of stay:</u> Not reported; 21-day inpatient	*1.1 Goal setting (behaviour)* *1.8 Behavioural contract*	n/a	n/a

Authors, publication details	Setting, country, n	Length of stay, intervention format, provider, mode	Inpatient intervention behaviour change techniques [b, c] (Michie *et al.*, 2015)	Post-discharge behaviour change techniques [c]	Control
	drug dependency treatment program, US, n=163	program Inpatient: Written agreement to adhere to new smoke-free policy, arranged by clinic staff Post-discharge: None	*11.1 Pharmacological support (clonidine)*		
Prochaska et al., 2006	University-based adult inpatient psychiatry unit, US, n=100	Length of stay: M (SD) = 6.4 (5.5) days, range = 1-37. Inpatient: Clinic staff provided treatment as usual Post-discharge: Occasionally NRT as part of treatment as usual	*11.1 Pharmacological support (NRT patch and/or gum)*	*11.1 Pharmacological support (NRT)*	n/a

Authors, publication details	Setting, country, n	Length of stay, intervention format, provider, mode	Inpatient intervention behaviour change techniques [b, c] (Michie *et al.*, 2015)	Post-discharge behaviour change techniques [c]	Control
Strong et al., 2012[a]	Two inpatient units in a psychiatric hospital, US, n=15	Length of stay: M (SD): 7.2 (2.6) days Inpatient: One face-to-face 45 minute Motivational Interviewing session, delivered by study staff, information on quitlines and treatment Post-discharge: Phone call 2 weeks post-discharge	*1.4 Action planning* *2.1 Monitoring of behaviour without feedback* *2.2 Feedback on behaviour* *8.2 Behaviour substitution* *9.2 Pros and cons* 11.1 Pharmacological support (NRT) *13.3 Incompatible beliefs* *13.4 Valued self-identity*	*1.2 Problem solving* *1.4 Action planning* *1.5 Review behaviour goal(s)* *3.1 Social support (unspecified)* *10.3 Non-specific reward*	Inpatient: 11.1 Pharmacological support (NRT) Post-discharge: No intervention
Stuyt, 2015[a]	90-day inpatient treatment program for co-occurring substance	Length of stay: Not reported; 90-day inpatient program. Inpatient: Tobacco topic is fully integrated into the program, delivered by	*1.2 Problem solving* *2.5 Monitoring outcome(s) of behaviour by others without feedback* *2.6 Biofeedback* *4.1 Instruction on how to perform a behaviour* *5.1 Information about health consequences*	n/a	n/a

Authors, publication details	Setting, country, n	Length of stay, intervention format, provider, mode	Inpatient intervention behaviour change techniques [b, c] (Michie *et al.*, 2015)	Post-discharge behaviour change techniques [c]	Control
	abuse and mental health problems, US, n=154 (4 deaths during follow-up)	centre staff, one-to-one and groups <u>Post-discharge:</u> None described	*5.3 Information about social and environmental consequences* *5.6 Information about emotional consequences* *11.1 Pharmacological support (Nicotine patch)*		

Abbreviations: n = Number of participants, NRT = Nicotine Replacement Therapy; US = United States

[a] Study author(s) provided additional information about study interventions in the form of intervention manuals or similar documents.

[b] In addition to the Behaviour Change Techniques (BCTs) described in the interventions, a smoke-free environment in itself delivers a number of BCTs for smoking cessation. These include restructuring the physical environment (BCT 12.1), restructuring the social environment (12.2), avoidance/reducing exposure to cues for the behaviour (12.3) and removing access to the reward (7.4). (Michie *et al.*, 2015)

[c] Number indicates position in clusters; cluster labels are: 1: 'Goals and planning', 2 'Feedback and monitoring', 3 'Social support', 4 'Shaping knowledge', 5 'Natural consequences', 6 'Comparison of behaviour', 7 'Associations', 8 'Repetition and substitution', 8 'Comparison of outcomes', 10 'Reward and threat', 11 'Regulation', 12 'Antecedents', 13 'Identity', 14 'Scheduled consequences', 15 'Self-belief', 16 'Covert learning'.

[d] Italics: Behaviour change techniques used in intervention but not in control.

Table 2 Outcomes of included studies; N = 10.

Study	Key smoking outcome measures, follow-ups, findings	Variables associated with smoking outcomes	Mental health and other substance use outcomes
RANDOMISED CONTROLLED TRIALS			
Clarke et al., 2013	Measures Self-reported 7-day smoking abstinence verified by urine cotinine level <200 ng/mL; Nicotine dependence (FTND); Time to first cigarette after release Follow-up 3 weeks and 3 months for those abstinent at 3 weeks Findings Abstinence: - 3-weeks: AOR = 6.6, 95% CI: 2.5-17.0 for intervention - 3-months: AOR = 5.3, 95% CI: 1.4-23.8 for intervention Time to first cigarette (3 week follow-up): Treatment main effect: β(SE) = 0.56 (0.16), hazard ratio = 1.75 (p=.001)	Associated with abstinence at 3-week follow-up Not smoked for >6 months (baseline): AOR=4.6, 95% CI: 1.7-12.4; Hispanic: AOR=3.2, 95% CI: 1.1-8.7; Planned not to smoke after release (baseline): AOR=1.6, 95% CI: 1.2-2.3	At 3-week follow-up: Perceived stress (PSS)M (SD) 21.5 (6.1) non-smoker vs 21.9 (6.3) smoker (non-significant); Depression (CES-D) M (SD) : 12.3 (4.9) non-smoker vs 12.8 (5.5) smoker (non-significant)
Gariti et al, 2002	Measures Self-reported 7-day smoking abstinence verified by CO reading ≤ 9 parts per million and urine cotinine level	None reported	Almost 47% of participants were abstinent for their primary drug of abuse at the follow up; No differences between groups

	<50 ng/mL; Time to relapse after discharge; Cigarettes per day <u>Follow up</u> 6 months <u>Findings</u> Abstinence: 6% of intervention vs 0% of control (χ^2 (1) = 0.002, p = .97); Time to first cigarette: 76% reported smoking the same day they were discharged, 92.7% smoked within a month of discharge, no differences between groups in the mean number of days before relapse, t(52)=0.65, p=.52; Cigarettes per day: Reduced for both groups F(1) = 21.1, p<.001; no differences between groups		
Hickman et al., 2015	<u>Measures</u> Self-reported 7-day smoking abstinence verified by CO reading ≤ 10 parts per million or a confirmation of participant's past 7 days non-smoking status obtained from friends, family, or case managers if a participant was unable	<u>Associated with abstinence over 12-month study period</u> Quitting over time: AOR = 1.16, 95% CI: 1.04-1.29; Higher social status in United States (baseline): AOR = 1.25, 95% CI: 1.04-1.50;	Over the 12 months of follow-up, 55% of control and 57% of intervention group participants were rehospitalised or seen by psychiatric emergency care

	to attend in person Follow-up 3, 6, and 12 months Findings Abstinence: - 3 months: 12.5% intervention vs 7.3% control - 6 months: 17.5% intervention vs 8.5% control - 12 months: 26.2% intervention vs 16.7% control Abstinence modelled over 12-month period: AOR = 1.76, 95% CI: 0.69-4.48 for intervention	Stronger desire to quit (baseline): AOR = 1.28, 95% CI: 1.06-1.55; Higher expectation of success with quitting (baseline: AOR = 1.26, 95% CI: 1.06-1.50	
Prochaska et al., 2014	Measures Self-reported 7-day smoking abstinence verified by CO reading ≤ 10 parts per million or confirmation of participant's past 7 days non-smoking status obtained from significant others if the participant was unable to attend in person Follow-up: 3, 6, 12, and 18 months Findings Abstinence:	Associated with abstinence over 18-month study period Higher expectation of success with quitting (baseline): AOR = 1.17, 95% CI: 1.06-1.31; Higher perceived difficulty with staying quit (baseline): AOR = 0.86, 95% CI: 0.76-0.97; Time to first cigarette < 30 min (baseline): AOR = 0.51, 95% CI: 0.26-0.96	Over an 18-month study period, 56% of control and 44% of intervention group participants were rehospitalised, t(223)=2.1, p=.036; this was predicted by: Usual care condition: AOR = 1.92, 95% CI: 1.06-3.49; Psychotic symptoms (BASIS-24): AOR = 1.43, 95% CI: 1.09-1.89; Unstable housing: AOR = 2.09, 95% CI: 1.12-3.92; ≥8 previous psychiatric hospitalisations vs none: AOR = 3.21, 95% CI: 1.37-7.54

	- 3 months: 13.9% intervention vs 3.2% control - 6 months: 14.4% intervention vs 6.5% control - 12 months: 19.4% intervention vs 10.9% control - 18 months: 20.0% intervention vs 7.7% control Abstinence modelled over 18-month period: AOR = 3.85, 95% CI: 1.39-11.11 for intervention (reverse of AOR = 0.26, 95% CI: 0.09-0.72 reported by authors)		
Stockings et al., 2014	<u>Measures</u> Self-reported continuous smoking abstinence verified by CO reading < 10 parts per million; Self-reported 7-day smoking abstinence verified by CO reading < 10 parts per million; ≥50% reduction in cigarettes per day; Quit attempts after hospitalisation; Nicotine dependence (FTND) <u>Follow-up</u> 1 week and 2, 4, and 6 months <u>Findings</u> Continuous abstinence:	Use of NRT associated with point prevalence abstinence at 4 months ($\chi^2(3) = 6.8$, p=.009), no other significant associations	Psychological distress (K10) over 6-month period: - Condition-by-time interaction: F(3,621)=1.48, p=.22 - Main effect of condition: F(1,621)=.04, p=.85 - Main effect of time: F(3,621)=63.2, p<.0001

	- 1-week: 5.8% intervention vs 1% control (p=.06) - 2 months: 2.9% intervention vs 0% control (p=.13) - 4 months: 1.9% intervention vs 0% control (p=.26) - 6 months: 1.9% intervention vs 0% control (p=.26) Point prevalence abstinence (intervention vs control): - 1 week: OR=1.37, 95% CI: 0.45-4.98 - 2 months: OR=2.27, 95% CI: 0.81-7.52 - 4 months: OR=6.46, 95% CI: 1.50-32.77 - 6 months: OR = 1.32, 95% CI: 0.47-4.36 Quit attempts at 6-month follow-up: OR = 2.89, 95% CI: 1.43-5.98 for intervention ≥50% reduction in cigarettes per day at 6-month follow-up: OR = 5.90, 95% CI: 2.89-15.25 for intervention FTND over 6-month period: - Condition-by-time interaction: F(3,406)=8.5, p<.0001 - Main effect of condition: F(1,215)=9.8, p=.002 - Main effect of time: F(3,406)=10.9, p<.0001		
COHORT STUDIES			
Jonas &	Measures	Associated with abstinence at follow-up	None reported

Eagle, 1991	Self-reported smoking abstinence; Cigarettes per day; Time to relapse after discharge <u>Follow-up</u> Varying from 6 to 18 months after discharge <u>Findings</u> Abstinence: 4/39 (10.3%) were non-smokers; Relapse: 28/35 (80%) relapsed immediately after discharge, 3/35 (8.6%) within one week, 2/35 (5.7%) one to four weeks, and 2/35 (5.7%) relapsed one month post-discharge	M (SD) cigarettes per day (baseline): 6.8 (5) non-smokers vs 23.4 (13.5) smokers, $t(34) = 2.4$, $p<.02$	
Joseph, 1993	<u>Measures</u> Self-reported smoking behaviour <u>Follow-up</u> On average 10.7 months post-discharge <u>Findings</u> Abstinence: 13/163 (8%) non-smokers after introduction of smoke-free policy vs 5/156 (3%) ($p<.05$) before smoke-free policy	None reported	Use of other substances at follow up: 145/163 (89% with smoke-free policy) vs 151/156 (97% pre-smoke-free policy) reported improvement in chemical dependency ($p=.15$)

Prochaska et al., 2006	Measures Self-reported 7-day smoking abstinence verified by CO reading ≤ 10 parts per million; Nicotine dependence (FTND); Time to relapse post-discharge; Initiation of quit attempt post-relapse Follow-up 1 week and 1 and 3 months post-discharge Findings Abstinence at 3 months: 4/100 (4%) were non-smokers, although had been relapsed after discharge Relapse: Ranged from seconds to 36 days, 76% reported smoking the same day they were discharged, with a median time to first cigarette of 5 minutes Quit attempts: 48% reported a 24-hour quit attempt after relapsing post-discharge	Associated with abstinence at 3-month follow up: Less perceived difficulty with staying quit (baseline): $F(1,97) = 4.16$, p=.044 Associated with relapse on the day of discharge vs later Heavier smoker (baseline): r=.18, p=.047; Higher FTND score: r=.19, p=.043; Stronger craving and urges to smoke during hospitalisation: r=.23, p=.014; Fewer lifetime quit attempts: r=-.19, p=.034; Fewer past year quit attempts: r=-.26, p=.008; Less desire for abstinence: r=-.29, p=.002; Lower expectation of success: r=-.32, p=.001; Pre-contemplation or contemplation vs preparation stage: $\chi^2(2) = 20.12$, p<.001; Non-abstinence related goals: OR=.26, p=.016; Depressive disorder: OR=3.3, p=.030 Associated with quit attempt initiation following relapse post-discharge Lower FTND score: r=-.22, p=.019;	During the 3-month follow-up period, 81% of participants had a mental health contact, 1/3 of them were rehospitalised. Rehospitalisation was not related to quit attempts.

		More past year quit attempts: r=.24, p=.018; Greater desire for abstinence: r=.26, p=.005; Greater expectation of success: r=.21, p=.025; Less perceived difficulty with staying quit (baseline): r=-.24, p=.013; Preparation stage: OR=5.7, p=.002; Goal of complete abstinence: OR=5.4, p=.003; NRT use post-discharge: OR=6.9, p<.001 Not smoking on the day of discharge: OR=6.7, p=.001	
Strong et al., 2012	<u>Measures</u> Self-reported 7-day smoking abstinence verified by CO reading < 8 parts per million; Quit attempt made and length of attempt; Cigarettes per day <u>Follow-up</u> 6 months post-discharge <u>Findings</u> Abstinence: No one abstinent Quit attempt: 6/15 (40%) reported attempt with median	None reported	<u>Depressive symptoms over 6-month period</u> No significant change in PHQ-9 scores over time, β(SE) = 0.08 (0.09), p=.33,

	length of 62 days, range: 2 to 110 days. Cigarettes per day: Average reduction of 7.16, t(10)=-2.4, p<.04		
Stuyt, 2015	<u>Measures</u> Self-reported tobacco abstinence in the past month verified by tissue testing results obtained from probation officers <u>Follow-up</u> Monthly for 12 months, only 12 months reported <u>Findings</u> Abstinence: 18/120 (15% of smokers at admission) were non-smokers	None reported	<u>Relapse to alcohol or drugs</u> 70/102 (69%) of smokers post-discharge vs 5/18 (28%) of non-smokers post-discharge, $\chi^2 = 10.9$, p=.001

FTND: Fagerstrom Test of Nicotine Dependence; PSS: Perceived stress scale; CES-D: Centre for Epidemiologic Studies Depression Scale; PHQ-9: nine item depression screen from Patient Health Questionnaire.

Table 3. Risk of bias (study quality) assessment (Armijo-Olivo *et al.*, 2012)

	Selection bias	Design	Confounders	Blinding	Data collection	Withdrawals and drop-outs	Global rating
RANDOMISED CONTROLLED TRIALS							
Clarke et al, 2013	2	1	1	2	1	2	Strong
Gariti et al, 2002	3	1	1	2	1	1	Moderate
Hickman et al, 2015	2	1	1	2	1	1	Strong
Prochaska et al, 2014	2	1	1	2	1	1	Strong
Stockings et al, 2014	2	1	1	2	1	2	Strong
COHORT STUDIES							
Jonas & Eagle, 1991	3	2	n/a	2	3	3	Weak
Joseph, 1993	3	2	3	2	3	n/a	Weak
Prochaska et al, 2006	2	2	n/a	2	1	1	Strong
Strong et al, 2012	3	3	n/a	2	1	n/a	Weak
Stuyt, 2015	1	2	n/a	2	3	1	Moderate

Abbreviation: n/a: Assessment item not applicable for a particular study design

Note: 1=strong, 2=moderate, 3=weak

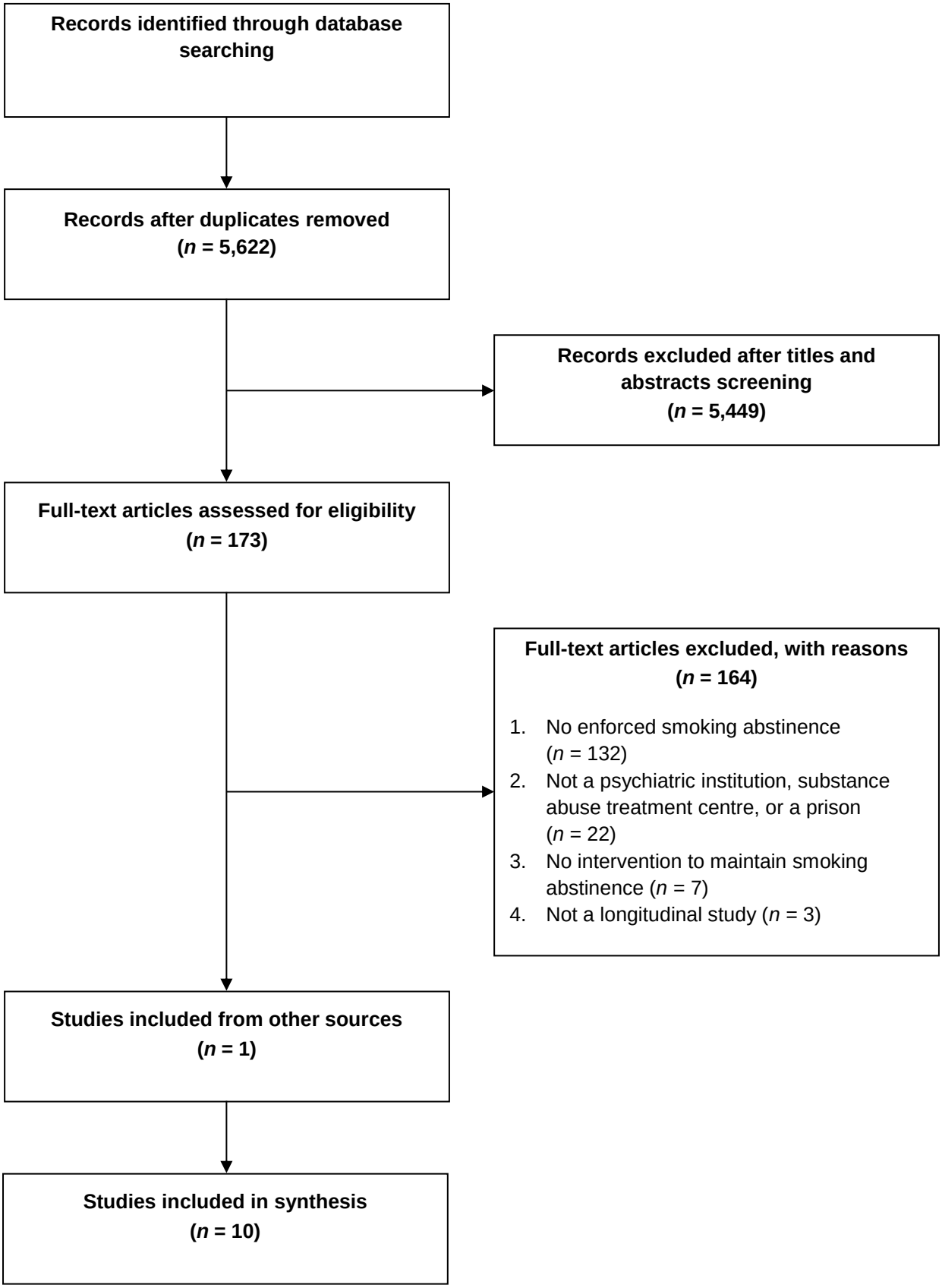
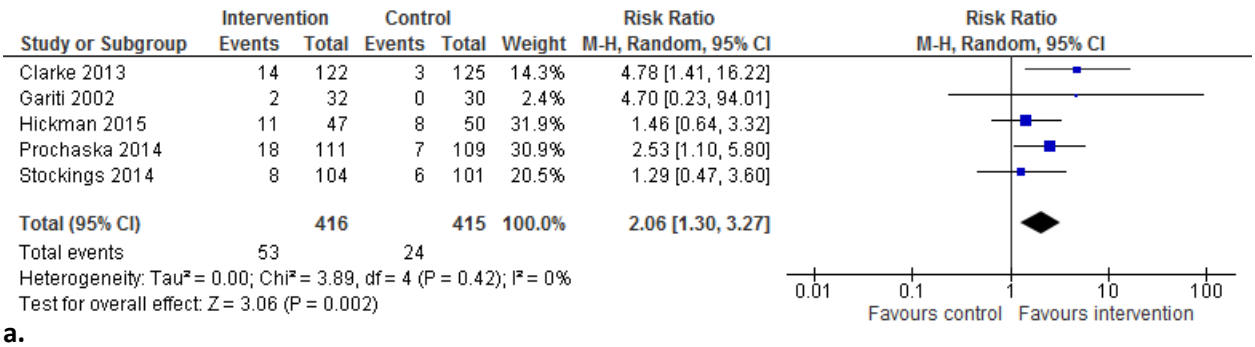
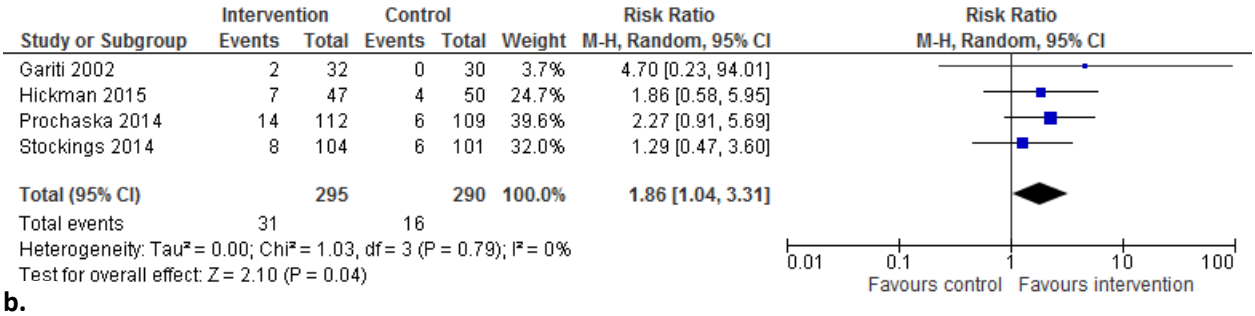


Figure 1. Study selection



a.



b.

Figure 2.

a. Comparison of biochemically verified point-prevalence abstinence at longest follow-up in randomised trials. Note: Length of follow-up: Clarke 3 months, Gariti 6 months, Hickman 12 months, Prochaska 18 months, Stockings 6 months.

b. Comparison of biochemically verified point-prevalence abstinence at 6 month follow-up in randomised trials.

Abbreviations: M-H=Mantel-Haenszel

Leonie S. Brose, Erikas Simonavicius & Ann McNeill. Maintaining abstinence from smoking after a period of enforced abstinence – systematic review, meta-analysis and analysis of behaviour change techniques with a focus on mental health. ***Psychological Medicine.***

Supplemental Material

Table S1. Frequency of studies that used particular behaviour change techniques in their interventions

Behaviour Change Technique	Total (max n=10)	Treatment as usual/control (max n=6)	Inpatient intervention (max n=10)	Post-discharge intervention (max n=7)	Example description
11.1 Pharmacological support	9	5	8	5	The setting was a locked unit with a complete smoking ban that managed patients' nicotine withdrawal with nicotine replacement therapy (NRT) during hospitalization. (Prochaska *et al.*, 2014)
1.2 Problem solving	6		4	2	CBT sessions teach smokers to recognize specific environmental and affective events ("triggers") that occur prior to smoking and to identify behavioral and cognitive strategies to cope with these triggers. (Clarke *et al.*, 2013)
3.1 Social support (unspecified)	6	3	5	4	The intervention group received one manually based individual session with an addiction therapist to explore motivation/ambivalence and provide a rationale for continuing smoking cessation post-discharge. (Gariti *et al.*, 2002)
9.2 Pros and cons	6		6		The project officer will conduct a brief (5-10 minutes) motivational interview by guiding the participant through a series of topics designed to motivate the participant towards positive health behaviour change, including: positives and negatives of smoking and quitting. (Stockings *et al.*, 2011)
5.3 Information about social and environ-mental consequences	5		5	1	Patients were encouraged to attend a group-oriented daily film series dealing with the hazards of smoking and how to quit successfully, and to discuss their reactions to the films. (Gariti *et al.*, 2002)
5.1 Information about health consequences	5		5	1	The patients are given a great deal of education on tobacco and its effects on the brain and body. (Stuyt, 2015) [a]

Behaviour Change Technique	Total (max n=10)	Treatment as usual/control (max n=6)	Inpatient intervention (max n=10)	Post-discharge intervention (max n=7)	Example description
5.6 Information about emotional consequences	5		5		In the Symptoms Management group they talk about how all the substances including tobacco play a role in anxiety or depression. (Stuyt, 2015) [a]
8.2 Behaviour substitution	5		4	1	Many change plans included specific steps for obtaining substitutes for cigarettes, such as gum or toothpicks. (Strong *et al.*, 2012)
1.4 Action planning	4		4	1	The final element of the intervention was to develop a change plan if appropriate. (Strong *et al.*, 2012)
1.1 Goal setting (behaviour)	4		4		Patients were required upon admission to the hospital to acknowledge the smoke-free policy and agree to nicotine abstinence during treatment. (Joseph, 1993)
9.3 Comparative imagining of future outcomes	4		4		How would life be in 5 years' time if you were still smoking and if you had quit smoking? What would it be like? (Stockings *et al.*, 2014) [a]
10.4 Social reward	4		2	2	What did client attempt? Reinforce attempts/accomplishments. (Clarke *et al.*, 2013) [a]
12.2 Restructuring the social environment	4		3	1	There are two ways to use your social network to help you stay quit, or quit again if you have experienced a relapse. One is to talk to your friends and family. Find ex-smokers and get their perspectives. (Clarke *et al.*, 2013) [a]
12.3 Avoidance/ reducing exposure to cues for the behaviour	4		3	1	AVOID high temptation situations. Don't go to places that you normally associate with smoking, at least for the first couple of days. (Clarke *et al.*, 2013) [a]
3.3 Social support (emotional)	3		3		Make a pact to call someone several times a day if you need help or just a morale boost. Also, agree that you will not smoke a cigarette until after you have talked with this person ...no matter what time it is or how late it is. (Clarke *et al.*, 2013) [a]

Behaviour Change Technique	Total (max n=10)	Treatment as usual/control (max n=6)	Inpatient intervention (max n=10)	Post-discharge intervention (max n=7)	Example description
4.1 Instruction on how to perform a behaviour	3		2	1	Groups will run on a rotating basis of one, one hour group for four weeks, and will follow an informational, group-oriented support and skills training format. (Stockings *et al.*, 2014)
4.2 Information about antecedents	3		3		People tend to be consistent in the type of situations that are high risk for them. You can anticipate them, prepare for them, and rehearse in your mind how you are going to deal with them. (Clarke *et al.*, 2013) [a]
7.1 Prompts/cues	3		2	1	If there are certain times/places/people/actions that make you feel more motivated to quit, visit them more often! A diary can help identify these cues as well. (Stockings *et al.*, 2014) [a]
8.1 Behavioural practice/rehearsal	3		3		If you have already learned RELAXATION skills, remember to use them when you are feeling stressed or irritable, even now, while you're here. It's good practice for when you go home. (Clarke *et al.*, 2013) [a]
10.3 Non-specific reward	3		2	1	Post quit sessions review/reinforce progress, revise plans for identifying high-risk situations, managing any side effects/withdrawal, review strategies for overcoming lapse events, and put in place reinforcement for successes. (Strong *et al.*, 2012)
11.2 Reduce negative emotions	3		3		Have something that you can do with your hands and/or mouth when you are doing boring or repetitive tasks. Bring a book, a crossword puzzle, or magazines... anything to reduce boredom. (Clarke *et al.*, 2013) [a]
12.1 Restructuring the physical environment	3		3		Do not keep any cigarettes in your home, car or at work. If you do not have easy access it will be easier to avoid smoking. (Clarke *et al.*, 2013) [a]
12.4 Distraction	3		2	1	If you are with friends, ask them how their weekend was, or what they are planning to do later to take your mind off the craving. (Stockings *et al.*, 2014) [a]
12.5 Adding objects to the environment	3		2	1	Avoid taking your cigarettes with you, but have your NRT on hand. (Stockings *et al.*, 2014) [a]

Behaviour Change Technique	Total (max n=10)	Treatment as usual/control (max n=6)	Inpatient intervention (max n=10)	Post-discharge intervention (max n=7)	Example description
12.6 Body changes	3		3		You can avoid smoking by ALTERING YOUR BODILY REACTIONS. If you are smoking because you are feeling tense, anxious, uptight, or jittery, you can be taught ways to relax and to reduce anxiety using RELAXATION TRAINING instead of smoking. (Clarke *et al.*, 2013) [a]
13.2 Framing/reframing	3		3		However, the important thing for right now is to be aware that the road to permanent smoking cessation is a path that goes up and down. There will be many temptations the day you get out but within a week or two, the hills become less steep and the valleys are less deep, but don't expect a completely flat road for a while. (Clarke *et al.*, 2013) [a]
13.5 Identity associated with changed behaviour	3		3		You are not a smoker again -- you're an ex-smoker who just has had a couple of cigarettes. Your levels of nicotine in your body are still very low. (Clarke *et al.*, 2013) [a]
15.2 Mental rehearsal of successful performance	3		3		Imagine yourself on the outside encountering the Triggers and using your new coping skills to avoid smoking. (Clarke *et al.*, 2013) [a]
15.3 Focus on past success	3		3		Keep in mind, you've been able to do without cigarettes while here. You've shown yourself that you can be without nicotine. (Clarke *et al.*, 2013) [a]
15.4 Self-talk	3		3		One way to cope with negative self-talk is to tell yourself something positive that will help you not to smoke instead. (Clarke *et al.*, 2013) [a]
16.2 Imaginary reward	3		3		You need to have one particularly vivid image that you can always fall back on to help you through the tough times -- a motivating image that keeps you going. These motivating images need not necessarily be positive and need to be specific. For example, a positive image may be the pride your children will show when you are not smoking. (Clarke *et al.*, 2013) [a]
1.4 Action planning	2		2		[b] Prompt detailed planning of performance of the behaviour. Context may be environmental (physical or social) or internal (physical, emotional or cognitive).

Behaviour Change Technique	Total (max n=10)	Treatment as usual/control (max n=6)	Inpatient intervention (max n=10)	Post-discharge intervention (max n=7)	Example description
1.9 Commitment	2		2		[b] Ask the person to affirm or reaffirm statements indicating commitment to change the behaviour.
2.1 Monitoring of behaviour without feedback	2		1	1	Topics covered include: uptake, usage, problems and effectiveness of intervention supports (NRT, Quitline, community smoking cessation support groups), fortnightly review of NRT dosage, assistance with NRT use, monitoring and managing nicotine withdrawal symptoms, daily cigarette consumption, techniques to improve smoking outcomes, and general psychological support and encouragement. (Stockings *et al.*, 2014)
2.3 Self-monitoring of behaviour	2		1	1	Writing down the cigarettes you smoke every day is called self-monitoring. Self-monitoring increases your awareness of your smoking patterns and puts you in a better position to change your habits and negative thoughts. (Clarke *et al.*, 2013) [a]
2.4 Self-monitoring of outcome(s) of behaviour	2		2		[b] Establish a method for the person to monitor and record the outcome(s) of their behaviour as part of a behaviour change strategy.
5.4 Monitoring of emotional consequences	2		1	1	How did you feel right after smoking the cigarette? What negative self-talk got to you? (Clarke *et al.*, 2013) [a]
6.2 Social comparison	2		2		[b] Draw attention to others' performance to allow comparison with the person's own performance.
6.3 Information about other's approval	2		2		[b] Provide information about what other people think about the behaviour. The information clarifies whether others will like, approve or disapprove of what the person is doing or will do.
8.7 Graded tasks	2		2		[b] Set easy-to-perform tasks, making them increasingly difficult, but achievable, until behaviour is performed.
10.9 Self-reward	2		2		[b] Prompt self-praise or self-reward if and only if there has been effort and/or progress in performing the behaviour.
13.4 Valued self-identity	2		2		What about you makes you think you can try your plan and have it work? (Clarke *et al.*, 2013) [a]

Behaviour Change Technique	Total (max n=10)	Treatment as usual/control (max n=6)	Inpatient intervention (max n=10)	Post-discharge intervention (max n=7)	Example description
1.5 Review behaviour goal(s)	1			1	Sometimes we set goals and later find they weren't right for us. That's ok. During the session today, you may decide on new goals, that's up to you. (Clarke *et al.*, 2013) [a]
1.7 Review outcome goal(s)	1			1	If not smoking: What new goals can you set? (Clarke *et al.*, 2013) [a]
1.8 Behavioural contract	1		1		This [agreement to nicotine abstinence] was confirmed in a written contract. (Joseph, 1993)
2.2 Feedback on behaviour	1		1		Provide personalised feedback using smoking-related information taken from the assessment. (Strong *et al.*, 2012)
2.5 Monitoring out-come(s) of behaviour by others without feedback	1		1		Breath carbon monoxide testing is utilized, in addition to urine drug screens for nicotine, alcohol, and other drug detection and breathalyzers for alcohol detection. (Stuyt, 2015)
2.6 Biofeedback	1		1		We also teach coping skills such as biofeedback, tapping (Emotion Freedom Technique) and offer the NADA 5-point ear acupuncture protocol several times a week to help with cravings and anxiety or things that trigger them to use/smoke. (Stuyt, 2015) [a]
4.3 Re-attribution	1			1	Adjust your thinking about the withdrawal symptoms. Focus on the biological component, not the emotional, for example try to change 'I need a cigarette' or 'I can't handle without a cigarette' to 'this is just a biological feeling of withdrawal, and it will pass soon'. (Stockings *et al.*, 2014) [a]
6.1 Demonstration of the behaviour	1		1		Patients were encouraged to attend a group-oriented daily film series dealing with the hazards of smoking and how to quit successfully, and to discuss their reactions to the films. (Gariti *et al.*, 2002)
7.4 Remove access to the reward	1		1		Pick one or two situations in which you will not smoke. (Clarke *et al.*, 2013) [a]

Behaviour Change Technique	Total (max n=10)	Treatment as usual/control (max n=6)	Inpatient intervention (max n=10)	Post-discharge intervention (max n=7)	Example description
8.3 Habit formation	1		1		We recommend that you practice using relaxation at least once per day. You can also use these relaxation breaks (2-5 minutes) instead of your usual "smoke breaks" or "coffee breaks". (Clarke *et al.*, 2013) [a]
8.4 Habit reversal	1		1		Remember that smoking has been repeated "millions" of times. In order for a coping strategy to work it has to become as frequently used and as comfortable to you as smoking was in the past. (Clarke *et al.*, 2013) [a]
11.3 Conserving mental resources	1		1		You may want to jot down your positive thoughts on an index card and keep the card handy so you can refer to it (i.e. in your pocket). (Clarke *et al.*, 2013) [a]
13.3 Incompatible beliefs	1		1		Explore broader goals and values of the participant and how smoking fits in with those. (Strong *et al.*, 2012)

Abbreviations: n: Number of studies

[a] Quoted example is from additional information provided by a particular author in the form of intervention manuals or similar documents.

[b] Examples used in studies not quoted due to a confidentiality and non-disclosure agreement in relation to the intervention manual for two trials (Hickman *et al.*, 2015, Prochaska *et al.*, 2014). The general BCT definition is shown instead (Michie *et al.*, 2015).

A1. Final search strategies for all databases.

MEDLINE

1. exp "Tobacco Use"/ or exp "Tobacco Use Disorder"/
2. (smok* or tobacco* or cigarette* or nicotine* or cigar*).ab,ti.
3. exp Inpatients/ or exp Hospitalization/ or exp prisoner/ or exp Mental Health Services/ or exp Hospitals, Psychiatric/ or exp prisons/ or exp smoke-free policy/ or exp Substance Abuse Treatment Centers/
4. (hospitali?ed or hospitali?ation* or inpatient* or in-patient* or inmate* or prison* or convict* or offender* or rehab* center or rehab* centre or smoke-free or smok* free or smokefree or ((smok* or tobacco) adj4 (ban or bans or banned or law or laws or policy or policies or prohibit* or restrict* or regulat* or legislat* or ordinance*))).ab,ti.
5. exp "Tobacco Use Cessation"/
6. ((smok* or tobacco or nicotine) adj3 (quit* or stop* or ceased or abstain* or abstin* or prevent* or cessation or reduction)).ab,ti.
7. exp Recurrence/ or exp treatment outcome/
8. (((relaps* or laps* or return to smok* or (smok* adj2 abstinence) or (abstinent adj2 smok*) or relapse) adj3 (prevent* or smok*)) or maintenance or recurrence).ab,ti.
9. cohort studies/ or longitudinal studies/ or follow-up studies/ or prospective studies/ or retrospective studies/ or cohort.ti,ab. or longitudinal.ti,ab. or prospective.ti,ab. or retrospective.ti,ab.
10. RANDOMIZED CONTROLLED TRIAL.pt.
11. CONTROLLED CLINICAL TRIAL.pt.
12. PRAGMATIC CLINICAL TRIAL.pt.
13. CLINICAL TRIAL.pt.
14. Meta analysis.pt.
15. exp Clinical Trial/
16. Random Allocation/
17. randomized controlled trials/
18. double blind method/
19. single blind method/
20. placebos/
21. Research Design/
22. ((clin$ adj5 trial$) or placebo$ or random$).ti,ab.
23. ((singl$ or doubl$ or trebl$ or tripl$) adj5 (blind$ or mask$)).ti,ab.
24. (volunteer$ or prospectiv$).ti,ab.
25. exp Follow Up Studies/

26. exp Retrospective Studies/
27. exp Prospective Studies/
28. exp Evaluation Studies/ or Program Evaluation.mp.
29. exp Cross Sectional Studies/
30. Comparative study/
31. exp Behavior therapy/
32. exp Health Promotion/
33. exp Community Health Services/
34. exp Health Behavior/ or exp Health Education/
35. 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34
36. smoking cessation.mp. or exp Smoking Cessation/
37. "Tobacco Use Cessation"/
38. "Tobacco Use Disorder"/
39. Tobacco Smokeless/
40. exp Tobacco Smoke Pollution/
41. exp Tobacco/
42. exp Nicotine/
43. ((quit$ or stop$ or ceas$ or giv$) adj5 smoking).ti,ab.
44. exp Smoking/pc, th
45. 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44
46. exp Smoking/ not 45
47. 10 or 11 or 12
48. 45 and 35
49. 45 and 47
50. (animals not humans).sh.
51. ((36 or 37 or 38 or 39) and REVIEW.pt.) not 48
52. 46 and 35
53. (52 and 47) not 50
54. 48 not 49 not 50
55. (45 and 47) not 50
56. 1 or 2 or 3 or 4
57. 5 or 6

58. 7 or 8
59. 9 or 55
60. 56 and 57 and 58 and 59
61. limit 60 to english
62. limit 61 to adult

EMBASE

1. exp "tobacco use"/
2. (smok* or tobacco* or cigarette* or nicotine* or cigar*).ab,ti.
3. exp hospital patient/ or exp hospitalization/ or exp prison/ or exp prisoner/ or exp mental hospital/ or exp mental health service/ or exp smoking ban/ or exp drug dependence treatment/
4. (hospitali?ed or hospitali?ation* or inpatient* or in-patient* or inmate* or prison* or convict* or offender* or rehab* center or rehab* centre or smoke-free or smok* free or smokefree or ((smok* or tobacco) adj4 (ban or bans or banned or law or laws or policy or policies or prohibit* or restrict* or regulat* or legislat* or ordinance*))).ab,ti.
5. exp smoking cessation/ or exp smoking cessation program/
6. ((smok* or tobacco or nicotine) adj3 (quit* or stop* or ceased or abstain* or abstin* or prevent* or cessation or reduction)).ab,ti.
7. exp relapse/ or exp treatment outcome/ or treatment response/
8. (((relaps* or laps* or return to smok* or (smok* adj2 abstinence) or (abstinent adj2 smok*) or relapse) adj3 (prevent* or smok*)) or maintenance or recurrence).ab,ti.
9. cohort studies/ or longitudinal studies/ or follow-up studies/ or prospective studies/ or retrospective studies/ or cohort.ti,ab. or longitudinal.ti,ab. or prospective.ti,ab. or retrospective.ti,ab.
10. (RANDOM$ or FACTORIAL$ or (CROSSOVER$ or CROSS OVER$) or PLACEBO$ or (DOUBL$ adj BLIND$) or (SINGL$ adj BLIND$) or ASSIGN$ or ALLOCAT$ or VOLUNTEER$).ti,ab.
11. CROSSOVER PROCEDURE/ or DOUBLE BLIND PROCEDURE/ or RANDOMIZED CONTROLLED TRIAL/ or SINGLE BLIND PROCEDURE/
12. 10 or 11
13. SMOKING CESSATION.mp.
14. exp SMOKING CESSATION/
15. exp SMOKING/
16. ((QUIT$ or STOP$ or CEAS$ or GIV$ or PREVENT$) adj SMOK$).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]
17. exp PASSIVE SMOKING/ or exp SMOKING HABIT/ or exp CIGARETTE SMOKING/ or exp "SMOKING CESSATION"/dem, der
18. 13 or 14 or 15 or 16 or 17
19. 12 and 18

20. 1 or 2 or 3 or 4
21. 5 or 6
22. 7 or 8
23. 9 or 19
24. 20 and 21 and 22 and 23
25. limit 24 to english
26. limit 25 to adult

PsycInfo

1. exp tobacco smoking/
2. (smok* or tobacco* or cigarette* or nicotine* or cigar*).ab,ti.
3. exp Hospitalized Patients/ or exp Hospitalization/ or exp prisoners/ or exp drug rehabilitation/ or smoke free.mp.
4. (hospitali?ed or hospitali?ation* or inpatient* or in-patient* or inmate* or prison* or convict* or offender* or rehab* center or rehab* centre or smoke-free or smok* free or smokefree or ((smok* or tobacco) adj4 (ban or bans or banned or law or laws or policy or policies or prohibit* or restrict* or regulat* or legislat* or ordinance*))).ab,ti.
5. exp smoking cessation/
6. ((smok* or tobacco or nicotine) adj3 (quit* or stop* or ceased or abstain* or abstin* or prevent* or cessation or reduction)).ab,ti.
7. exp treatment outcomes/ or exp "Relapse (Disorders)"/
8. (((relaps* or laps* or return to smok* or (smok* adj2 abstinence) or (abstinent adj2 smok*) or relapse) adj3 (prevent* or smok*)) or maintenance or recurrence).ab,ti.
9. ((cohort or longitudinal or prospective or retrospective).ti,ab,id. or longitudinal study.md. or prospective study.md. or retrospective study.md.) not "Literature Review".md.
10. SMOKING CESSATION.mp. or exp SMOKING CESSATION/
11. (ANTISMOKING or ANTI SMOKING).mp.
12. (QUIT$ or CESSAT$).mp.
13. (ABSTIN$ or ABSTAIN$).mp.
14. (CONTROL$ adj SMOK$).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]
15. exp BEHAVIOR MODIFICATION/
16. 11 or 12 or 13 or 14 or 15
17. TOBACCO SMOKING/
18. (SMOK$ or CIGAR$ or TOBACCO$).mp.
19. PREVENTION/
20. 17 or 18

21. 16 and 20
22. 19 and 20
23. 10 or 21 or 22
24. 1 or 2 or 3 or 4
25. 5 or 6
26. 7 or 8
27. 9 or 23
28. 24 and 25 and 26 and 27
29. limit 28 to english
30. limit 29 to adult

CINAHL

S1 (MH "Smoking+")
S2 TI (smok* OR tobacco* OR cigarette* OR nicotine* OR cigar*) OR AB (smok* OR tobacco* OR cigarette* OR nicotine* OR cigar*)
S3 (MH "Inpatients") OR (MH "Psychiatric Patients+")
S4 (MH "Prisoners") OR (MH "Correctional Health Services") OR (MH "Correctional Facilities")
S5 TI (hospitali?ed or hospitali?ation* or inpatient* or in-patient* or inmate* or prison* or convict*) OR AB (hospitali?ed or hospitali?ation* or inpatient* or in-patient* or inmate* or prison* or convict*)
S6 (MH "Smoking Cessation") OR (MH "Smoking Cessation Programs") OR (MH "Smoking Cessation Assistance (Iowa NIC)") OR (MH "Tobacco Use Cessation Products+")
S7 TI ((smok* N cessation) or (smok* N reduction) or stop smoking or (tobacco N2 cessation) or (tobacco N2 reduction) or (nicotine* N2 cessation) or (nicotine* N2 reduction) or (quit N smok*)) OR AB ((smok* N cessation) or (smok* N reduction) or stop smoking or (tobacco N2 cessation) or (tobacco N2 reduction) or (nicotine* N2 cessation) or (nicotine* N2 reduction) or (quit N smok*))
S8 (MH "Recurrence")
S9 TI (relaps* or laps* or return to smok* or (smok* N abstinence) or (abstinent N smok*)) OR AB (relaps* or laps* or return to smok* or (smok* N abstinence) or (abstinent N smok*))
S10 (TI longitudinal* OR AB longitudinal* OR TI prospective OR AB prospective OR TI cohort OR AB cohort OR TI follow-up OR AB follow-up OR TI follow up OR AB follow up OR TI baseline OR AB baseline OR TI wave* OR AB wave* OR TI panel OR AB panel OR TI predict* OR AB predict*)
S11 (TX (random* OR factorial* OR placebo* OR assign* OR allocat*)) OR (TX (trial and (control* OR comparative))) OR TX "treatment arm" OR TX "control group*" OR (MH (Random assignment OR Clinical Trials+ OR Quantitative Studies)) OR TX RCT OR MH Placebos
S12 S1 OR S2 OR S3 OR S4
S13 S5 OR S6 OR S7
S14 S8 OR S9

S15 S10 OR S11
S16 S12 AND S13 AND S14 AND S15

Web of Science

#7 (#6 AND #5 AND #4 AND #1) AND LANGUAGE: (English)
#6 #3 OR #2
#5 TS= clinical trial* OR TS=research design OR TS=comparative stud* OR TS=evaluation stud* OR TS=controlled trial* OR TS=follow-up stud* OR TS=prospective stud* OR TS=random* OR TS=placebo* OR TS=(single blind*) OR TS=(double blind*)
#4 ti=(relaps* or laps* or return to smok* or (smok* near/2 abstinence) or (abstinent near/2 smok*) or relapse near/3 (prevent* or smok*) or maintenance or recurrence)
#3 ti=((smok* or tobacco or nicotine) near/3 (quit* or stop* or ceased or abstain* or abstin* or prevent* or cessation or reduction))
#2 ti=(hospitali?ed or hospitali?ation* or inpatient* or in-patient* or inmate* or prison* or convict* or offender* or rehab* center or rehab* centre or smoke-free or smok* free or smokefree or ((smok* or tobacco) near/4 (ban or bans or banned or law or laws or policy or policies or prohibit* or restrict* or regulat* or legislat* or ordinance*)))
#1 ts=(smok* or tobacco* or cigarette* or nicotine* or cigar*)

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